

A Study of Mercury Bioaccumulation in River Ecosystems

USGS Collaborators

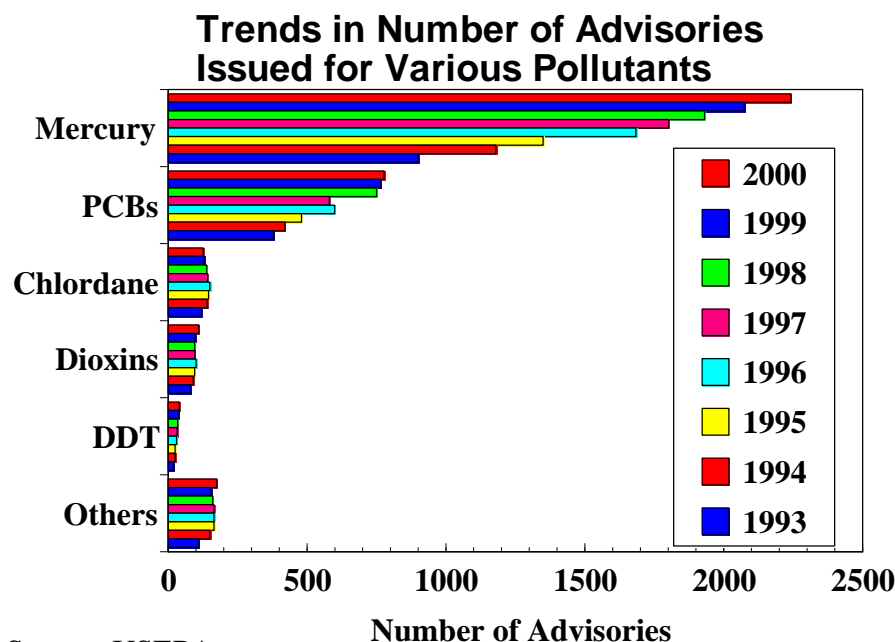
- NAWQA (National Water-Quality Assessment Program)
- Toxics Program
- National Research Program
- Multi-discipline:
 - Water, Biology, Geology

Mercury Concerns

- Widespread (global) and highly toxic
- Many forms; bacteria can convert these forms to methylmercury
- Methylmercury is bioaccumulated by all aquatic organisms
- Methylmercury is biomagnified
- Potentially serious human-health effects

Mercury is by far the leading cause for contaminant-related, human-health advisories in the US

November 5, 2002



Source: USEPA

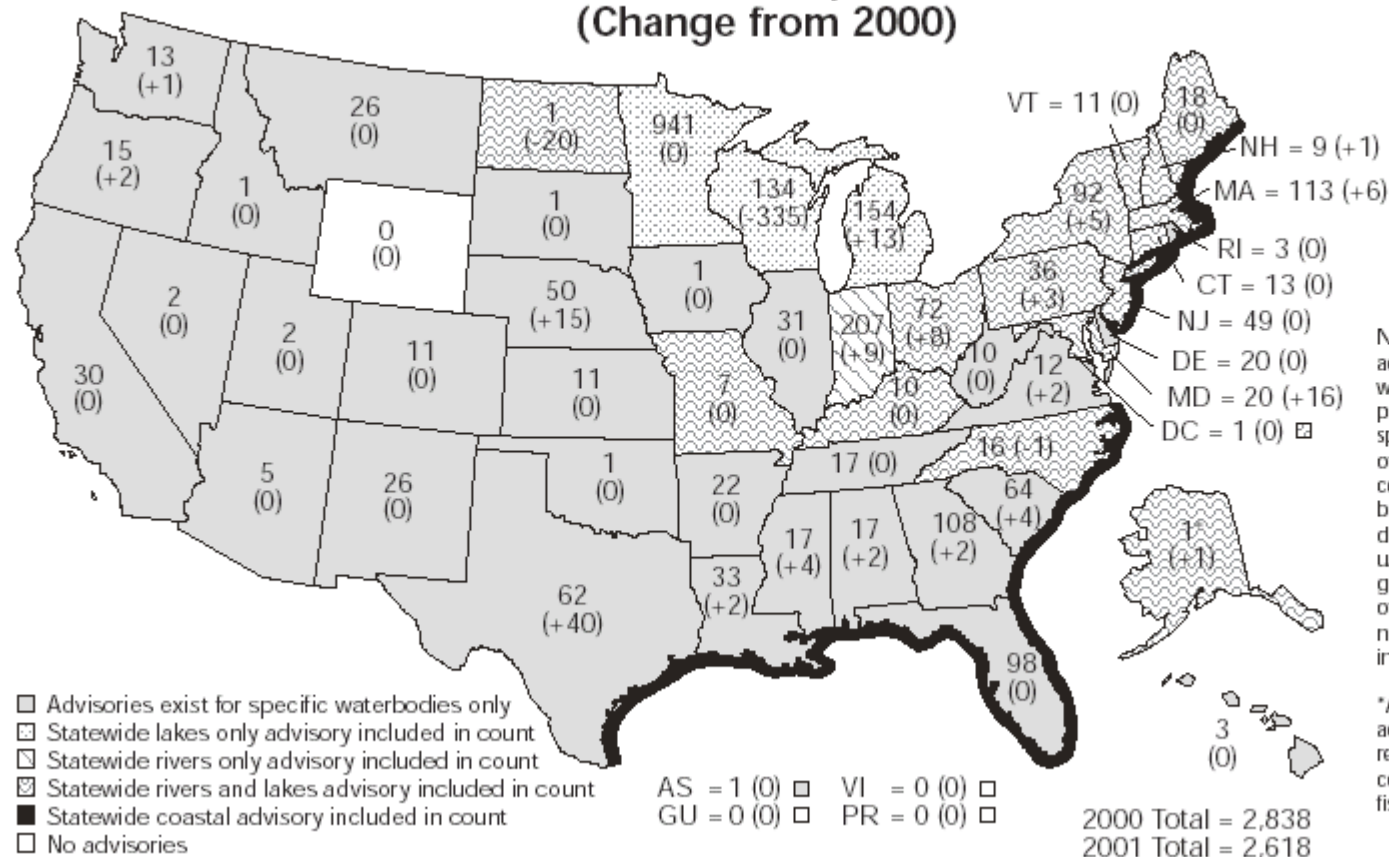
People who eat a lot of fish may run health risk

Study finds elevated consumption can lead to high intake of mercury

Fish-consumption advisories exist in 40 states and account for 79% of all such advisories in the Nation (USEPA, 2001)

Figure 1

Total Number of Fish Consumption Advisories – 2001 (Change from 2000)



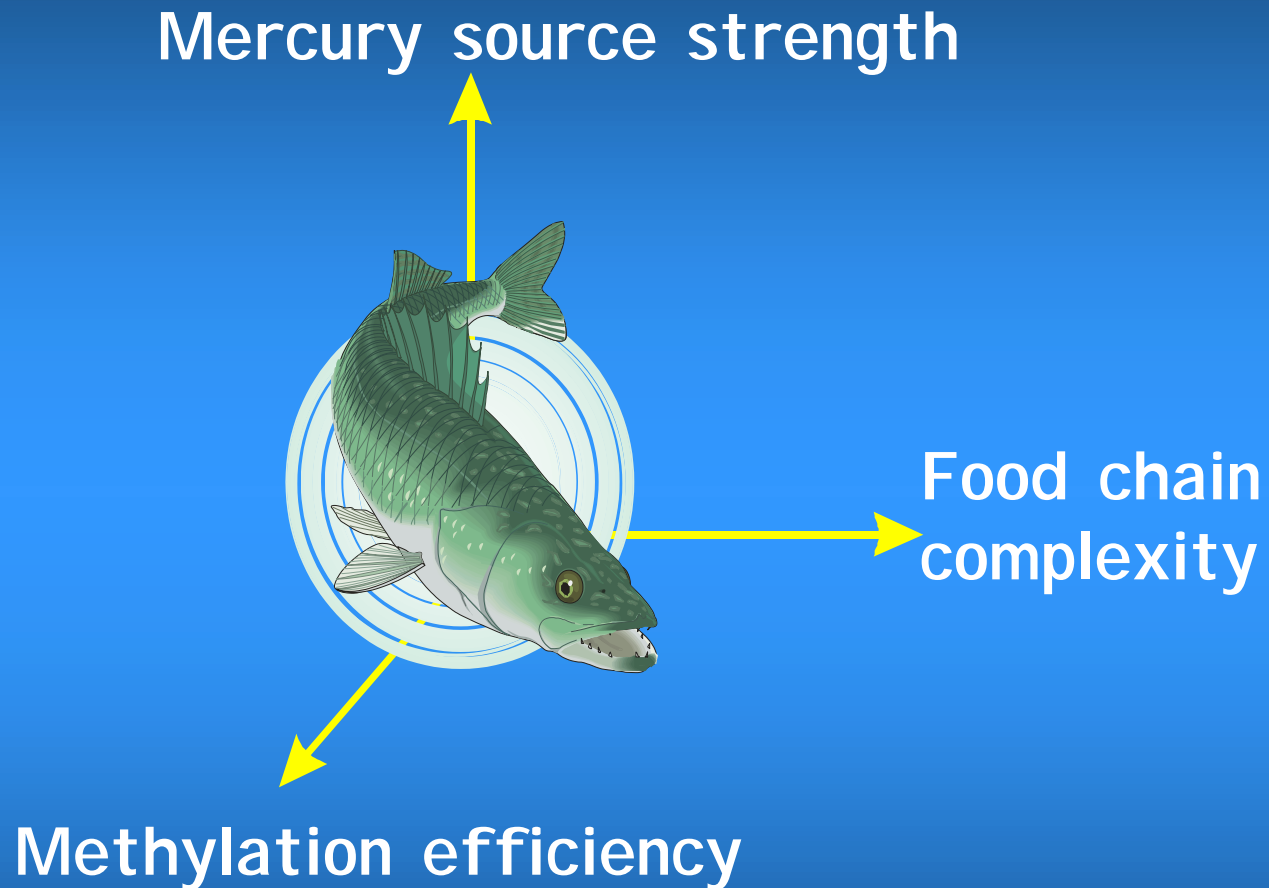
Note: A statewide advisory is issued to warn the public of the potential for wide-spread contamination of specific species in certain types of waterbodies. State advisory data should not be used for characterizing geographic distribution of chemical contaminants or for making interstate comparisons.

*Alaska's statewide advice places no restrictions on consumption of fish or wildlife.

General Objective

- Determine the effects of source strength, methylation efficiency, and food-web interactions (food-web complexity) on bioaccumulation of mercury in fish in stream ecosystems

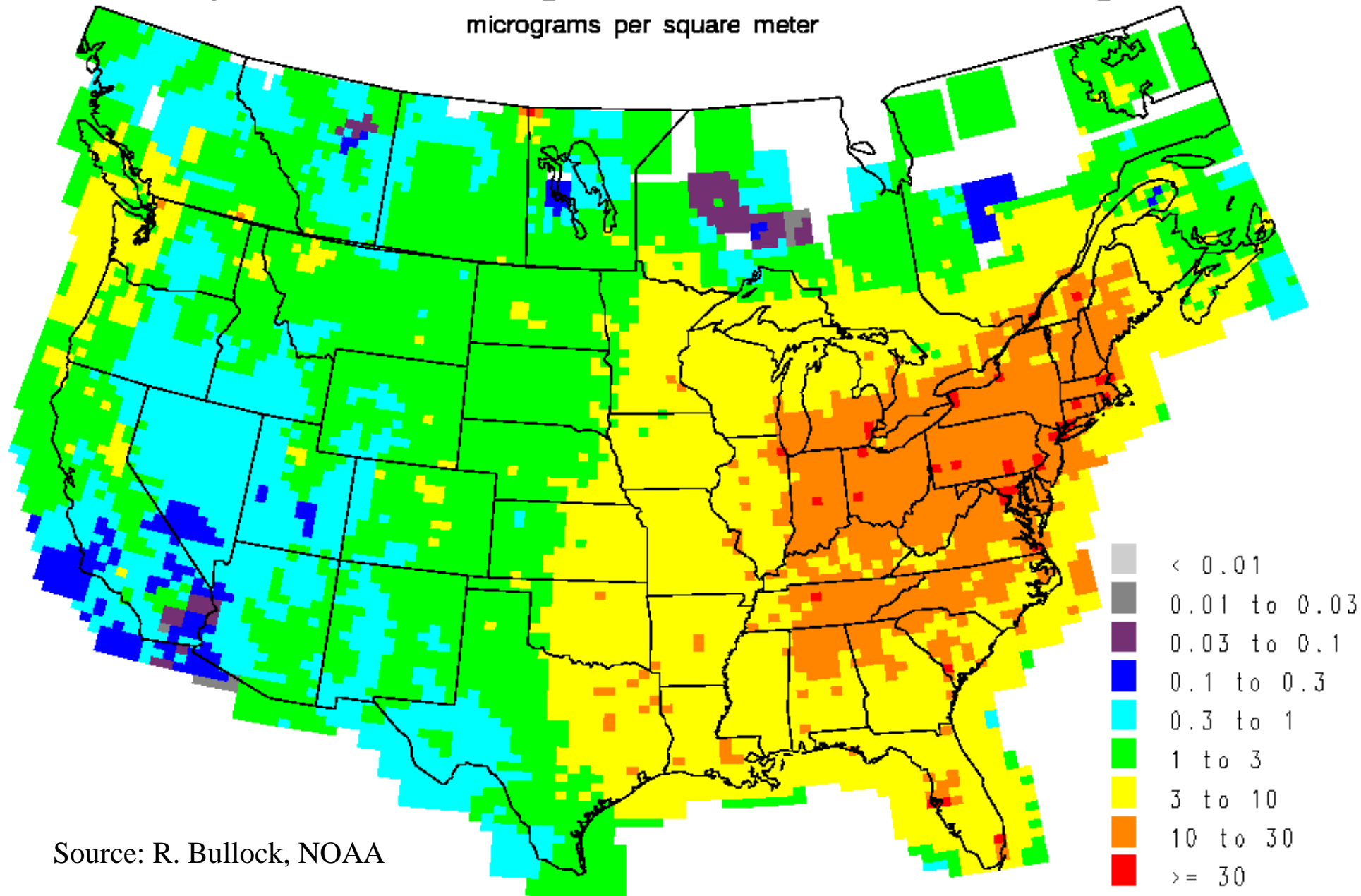
Factors in Mercury Bioaccumulation



After T.E. Mumley and K.E. Abu-Saba, in press.

Wet Deposition – Total Hg from USA, Canada and Background

micrograms per square meter



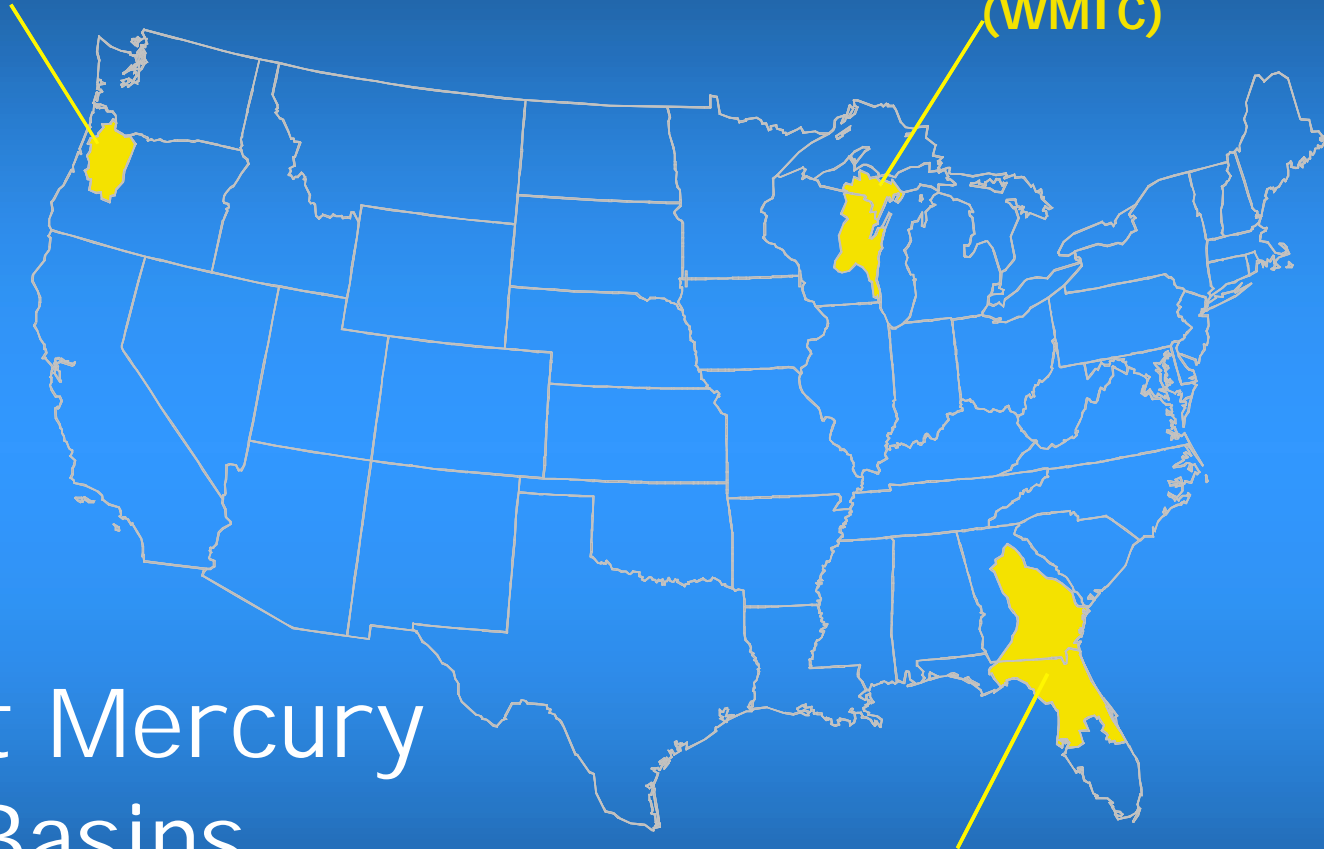
Source: R. Bullock, NOAA

**Willamette Basin
(WILL)**

**Western Lake
Michigan Drainages
(WMIC)**

**Georgia-Florida
Coastal Plain
Drainages (GAFL)**

Current Mercury
Study Basins



Approach - Site Selection

- ◆ 3 Sites per NAWQA Study Basin
- ◆ Mercury landscape type
 - ◆ 1 Urban
 - ◆ 2 Rural/non-cultivated (low/high % wetland)
- ◆ USGS gaged streams
- ◆ Availability of target species
- ◆ Range of food web complexity

Approach – Multi-media

- ◆ **Water:** 18x yr, 2 years (2003-4)
 - Dissolved and Particulate THg and MeHg
 - DOC, Sulfate, Suspended sediment
 - Stable isotopes of particulate organic matter
- ◆ **Sediment:** 2x yr, 2 years (2003-4)
 - THg and MeHg
 - Acid-volatile sulfide
 - Microbial methylation efficiency
 - Stable isotopes ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$)
- ◆ **Biota:** 1 year (2003 only)
 - THg (fish); THg and MeHg (inverts only)
 - Stable isotopes ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$)

Determine the influence of food-web complexity on mercury contamination in top predator fish

- How does food-chain length (# of steps between base of food web and apical fish) affect mercury concentrations in fish in diverse stream ecosystems?
- What is the influence of specific differences in food-web structure (e.g., food sources, species type, and habitat utilization) on mercury bioaccumulation?

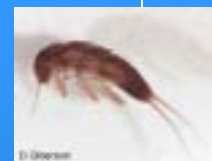
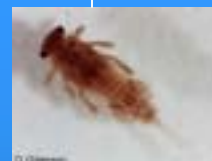
Top Predators



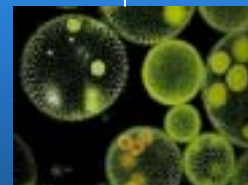
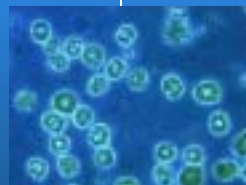
Secondary Consumers



Primary Consumers



Primary Producers / Detritus



Top Predators



Sample Once
2 species
6 individuals each
Fillets (skin-off)
Length, weight
THg
 $\delta^{13}\text{C}$, $\delta^{15}\text{N}$

Food Organisms

Forage Fish



Sample twice
2 species
6 individuals each
Whole body
Length, weight
THg
 $\delta^{13}\text{C}$, $\delta^{15}\text{N}$

Benthic Invertebrates



Sample twice
2 species
Triplicate composites of > 30
THg and MeHg
 $\delta^{13}\text{C}$, $\delta^{15}\text{N}$

